

**TOP SECRET**

SC-02164/58

No. Pages: 86

COPY NO.: 27

25X1

25X1

# ELECTRONIC ASPECTS OF THE SOVIET AIR DEFENSE SYSTEM

DECLASS REVIEW by NIMA/DOD



CIA /SI/HTA/SIR-2/58

CONTAINS SENSITIVE  
UNCLASSIFIED INFORMATION

3 MARCH 1958

25X1

## CENTRAL INTELLIGENCE AGENCY OFFICE of SCIENTIFIC INTELLIGENCE

**WARNING**

25X1

DOCUMENT NO. 2  
NO CHANGE IN CLASS. ☐  
☐ DECLASSIFIED  
CLASS. CHANGED TO: TS (S) C  
NEXT REVIEW DATE: 07/07/92  
AUTH: HR 70-2  
DATE: 07/07/92 REVIEWER: CL

**TOP SECRET**

**WARNING**

**This material contains information affecting the National Defense of the United States within the meaning of the espionage laws, Title 18, USC, Secs. 793 and 794, the transmission or revelation of which in any manner to an unauthorized person is prohibited by law.**

TOP SECRET

25X1

SC-02164-58

SCIENTIFIC INTELLIGENCE REPORT

ELECTRONICS ASPECTS OF THE SOVIET

AIR DEFENSE SYSTEM

CIA/SI/HTA/SIR-2/58

3 March 1958

CENTRAL INTELLIGENCE AGENCY  
OFFICE OF SCIENTIFIC INTELLIGENCE

TOP SECRET

25X1

~~TOP SECRET~~

25X1

SC-02164-58

PREFACE

This study presents, in some detail, performance which the Soviet air defense system has demonstrated.

It should be noted that the performance of the Soviet air defense system as indicated in this report is based upon reaction to one to three aircraft only. Consequently, effectiveness in the presence of large numbers of intruding aircraft is not treated and cannot be judged.

The factual data presented are considered adequate to support strategic planners. Inasmuch as this is a dynamic system, planners of specific missions should consult the most recent intelligence available.

The cooperation of the USAF Strategic Air Command (SAC) has been most valuable in providing detailed information on Soviet reaction to SAC operations, radar and air order of battle. The views expressed however are those of CIA. They have not been coordinated with AFCIN or SAC.

Certain information has been omitted from this report to facilitate distribution however, such information has been considered in the study, and is reflected in the conclusions. Information as late as [ ] is used in this report.

25X1

iii

~~TOP SECRET~~

25X1

~~TOP SECRET~~

25X1

SC-02164-58

TABLE OF CONTENTS

PROBLEM

CONCLUSIONS

SUMMARY

DISCUSSION

Introduction  
Organization

THE AIR DEFENSE WARNING SYSTEM

DATA HANDLING IN THE AIR WARNING SYSTEM

Radar  
Filter Centers  
INERT  
Rate and Capacity  
Fighter Control  
Deployment

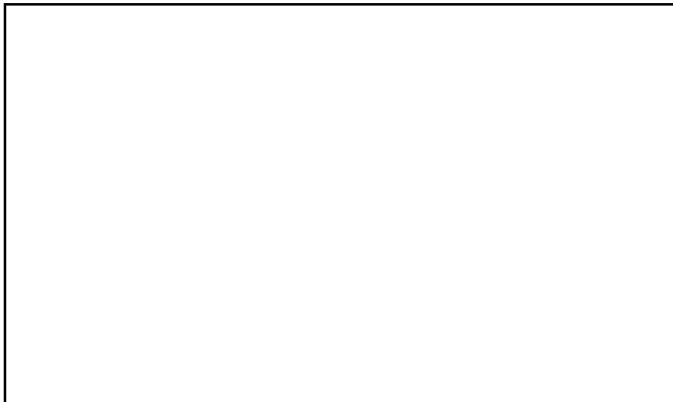
PERFORMANCE OF THE SOVIET AIR DEFENSE SYSTEM

Medium Altitudes (5000-40,000 feet)

Strategic Air Command USAF  
Baltic Sea Area (5000-40,000 feet)  
Black Sea Area (5000-40,000 feet)  
Trans Caucasus Area (5000-40,000 feet)  
Barents Sea Area (5000-40,000 feet)  
East Siberian Sea and Chukotsk Peninsula  
Bering Sea Area (5000-40,000 feet)  
Kurile Islands and Sea of Okhotsk (5000-40,000 feet)  
Sea of Japan (5000-40,000 feet)  
Summary (5000 feet to 40,000 feet)

High Altitude (above 40,000 feet)

25X1



v

~~TOP SECRET~~

25X1

TOP SECRET

25X1

SC-02164-58



Summary (above 40,000 feet)

Low Altitude (below 5000 feet)

#### ELECTRONICS EQUIPMENT FOR AIR DEFENSE

- Early Warning and GCI Radar
- Aircraft Control Communications
- Point to Point Ground Communications
- Identification
- Airborne Aids To Interception
- Landing and Navigation Aids
- Antiaircraft Artillery Fire Control
- Surface-to-Air Guided Missile Guidance
- Air-to-Air Missile Guidance
- Electronics Countermeasures

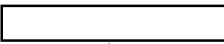
#### GENERAL COMMENTS ON THE SOVIET AIR DEFENSE SYSTEM

TOP SECRET

25X1

~~TOP SECRET~~

## LIST OF FIGURES

		Follows Page
1. Chart	Most Used Frequencies in the Soviet Bloc Air Defense System	4
2. Map	Baltic Fleet ADD, Baltic ADD, and Leningrad ADD	12
3. Map	Belorussian ADD, Kiev ADD, and Lvov ADD	12
4. Map	Chukotsk ADD	12
25X6 5. Map	 Poland ADD, and Czechoslovakia ADD	12
6. Map	Hungary ADD, Rumania ADD, Bulgaria ADD, and Finland ADD	12
7. Map	Kamchatka ADD	12
8. Map	Khabarovsk ADD	12
9. Map	Moscow ADD	12
10. Map	North Caucasus ADD	12
11. Map	Northern ADD	12
12. Map	Northern Fleet ADD and White Sea ADD	12
13. Map	Odessa ADD and Black Sea ADD	12
14. Map	Sovetskaya Gavan ADD and Sakhalin ADD	12
15. Map	Tashkent ADD	12
16. Map	Tbilisi ADD and Baku ADD	12
17. Map	Vladivostok ADD	12

25X1

~~TOP SECRET~~

25X1


~~TOP SECRET~~

25X1

## LIST OF FIGURES (Cont'd)

25X1

Follows  
Page

- 
33. Plots Eleven low-level night time penetrations conducted during 1953 32  
and 1954
34. Photos ROCK CAKE, FISH NET, TOKEN, FISH NET, and KNIFE REST "B" 34  
KNIFE REST "A" with FISH NET at right  
KNIFE REST "B" with FISH NET at left
35. Photos TOKEN 34  
ROCK CAKE  
GAGE and PATTY CAKE
36. Photos BIG MESH 36  
BIG MESH with TOKEN at left
37. Photos STRIKE OUT with ROCK CAKE at far left 36  
STRIKE OUT  
New large radar
38. Photos FRESCO "D" with SCAN ODD 38  
FLASHLIGHT "A" with SCAN THREE  
FLASHLIGHT "C" with SCAN THREE

~~TOP SECRET~~

25X1

TOP SECRET

25X1

SC-02164-58

PROBLEM

To study and assess the electronics aspects of the Soviet air defense system.

CONCLUSIONS

1. The Soviet air defense is by far the largest in the world in terms of area covered, number of radars, quantity of other electronics equipment, and communication networks. The Soviet air defense system is currently organized as a unified operational body controlled by Main PVO Command Posts located at Moscow and Khabarovsk. Although centralized, it is organized to permit maximum decentralization should tactical considerations dictate. The organizational structure, deployment of radars and communication networks, and fighter aircraft show that Soviet air defenses are based chiefly on fighter aircraft and are designed to cope with the threat posed by Western bombers. Surface-to-air guided missiles are included in the system at least in the Moscow area and air-to-air missiles probably are available in some areas.

2. Electronics systems effectively cover the approaches to all important areas in the Soviet Bloc. These electronics systems provide for detection, identification, tracking, communications, filtering, GCI and airborne interception, navigation and landing aids, guidance of antiaircraft missiles, antiaircraft artillery fire control, and electronics countermeasures.

3. The early warning system, VNOS, provides good warning and tracking of aircraft in a grid system which is common to the entire Bloc. In general, the size of the grid squares, not the accuracy of the radars, limits the accuracy of early warning reports of aircraft position to 2-3 miles.

4. Radar coverage has been clearly demonstrated to extend to 72,000 feet and is estimated to extend to the 85,000-100,000 foot region. In this respect at least, the electronics capabilities of the system exceed the capabilities of Soviet fighters to a significant degree. Height-finding varies from poor to excellent and in general is fairly good. In the vicinity of ROCK CAKE heightfinder radars, height measurement is usually highly accurate.

5. Low altitude performance of the electronics system is nil to poor against aircraft flying at 200-300 feet above the terrain. While detection would probably occur, tracking would be ineffective. However, at altitudes of 2000-3000 feet above the terrain tracking may be expected to be fairly good.

6. The Soviet air defense system is quite flexible. It has the ability to integrate new equipment rapidly and has flexibility in its operational aspects. Tracks are passed from Air Defense District to Air Defense District, fighters can be controlled by other than their parent organization, fighters are moved in response to a threat, and tactical   as well as random plots from ships are quickly integrated into the air defense system.

7. Performance of the electronics aspects of the system appear quite good in reaction to a few aircraft, but adequate intelligence data on large scale exercises involving many aircraft are not available. Confusion does develop in the presence of large numbers of tracks. Detailed assessment cannot be made.

TOP SECRET

25X1

TOP SECRET

25X1

SC-02164-58

25X1

9. The Soviet air defense system has been, and still is, under continuous revision as improvements in organization, operating procedures and new equipment are evolved. Perhaps one of the most important developments in the electronics aspects of the Soviet air defense system since the introduction of airborne intercept radar in 1954 is the introduction in 1956 of a data link means of rapidly passing radar plots and interceptor control commands. This should greatly relieve the traffic capacity problems which have existed in their air defense communications circuits. This development is believed to indicate Soviet introduction of a system which is similar in concept to the US SAGE system.

#### SUMMARY

Air Defense in the USSR is coequal with the Air Forces, Ground Forces, and Naval Forces at the Ministry of Defense level. The air defense forces derive equipment and personnel from the Ground, Naval, and Air Forces which have administrative control over the elements provided. The operational control rests with the Commander in Chief of the Air Defense Forces (PVO). Both the Navy and the Tactical Air Forces contribute to air defense.

Operational control of the PVO appears to be centered in two Main PVO Command Posts, one at Moscow and the other at Khabarovsk. The basic organizational and operational unit in the air defense system is the Air Defense District (ADD). The ADD covers a major geographic area and is usually divided into subdistricts. These elements of the PVO are provided with the equipment and facilities necessary for air defense.

The airwarning system (VNOS) of the air defense system is a vast organization which includes communications, radars, filter centers, and means for identification of aircraft. Radar sites, usually including more than one type of radar, provide for detection and tracking of aircraft. Tracks are transmitted to subdistrict filter centers where they are converted from range/azimuth positions into the VNOS grid which places the track in a common geographic reference system used throughout the Bloc. The sub-district filter center broadcasts the plot to the ADD filter center in a standard PVO format which includes various data such as track number, location, time, altitude, etc. These plots are rebroadcast by the ADD to Moscow and to adjacent ADDs.

Since mid-1956 a data transmission system has been noted in use in the air defense system. This data system is known as INERT in the US. INERT plays two roles in Soviet air defense, namely, reporting of aircraft tracks from the radar to the filter center and instructions from GCI controller to an interceptor. INERT is believed to indicate the Soviet introduction of a system similar in concept to the US SAGE system. For convenience the radar reporting portion of INERT which operates in the high frequency band will be referred to as HF INERT, while the aircraft control portion which operates in the very high frequency band will be referred to as VHF INERT. HF INERT provides a greatly increased communications capacity for reporting aircraft tracks.

- 2 -

TOP SECRET

25X1

TOP SECRET

25X1

SC-02164-58

25X1

Fighters operate under a Division Fighter Control which is equipped with GCI radar or under regimental control if out of range of the division GCI radar. The regiments also have radar suitable for GCI use. The communications capacity limitation imposed by the four channel VHF radio carried by the fighters seems to be undergoing a change with the introduction of VHF INSERT which is a data link system for transmitting commands to the aircraft by the GCI controller. This should cause a considerable increase in the number of fighters which can be controlled at one time.

The large number of fighters (some 14,000 estimated), the organization of the FVO, and its geographic deployment, indicates that the air defense of the USSR is based chiefly upon fighter aircraft, although guided missiles and anti-aircraft artillery are also in use.

Western reconnaissance aircraft have been in contact with the Soviet air defense system since the end of World War II. An estimated million miles of flight path have been flown (one-half million within the past two years) on the periphery and over the Bloc. The performance of the system is based upon the analysis of data resulting from these missions.

In the medium altitudes (5000-40,000 feet) the Soviet air defense system may be expected to detect approaching aircraft by the time they are within 100 miles (170-180 miles in some regions) of Soviet or Bloc territory. Aircraft will remain under surveillance as long as they are within the sensitive area. Fighters will usually be scrambled and placed on defensive patrol and occasionally interceptions will be made. Only rarely will an overt hostile act be committed by the fighters although if provoked the fighters may be expected to retaliate. Identification will be prompt. Heightfinding although initially poor two years ago is fairly accurate now and in areas where the ROCK CAVE heightfinder radars are installed, height finding is quite accurate. These radars have been coming into widespread use over the past two years.

In the high altitude region (above 40,000 feet), detection of aircraft up to 72,000 feet has been adequately demonstrated. The high altitude coverage of the Soviet detection and tracking system is believed to extend above the 72,000 foot level and probably extends to the 85,000-100,000 foot region. The Soviets demonstrated an ability to close a track of 3000 miles over some four or five ADNs early in the period of high altitude penetrations. In the more recent operations, visual contacts with mission aircraft have become more frequent indicating ability to place fighters under GCI control within reasonable distance of the intruder. These visual contacts also point out the fact that the electronics of the air defense system surpass the capabilities of the fighters which are not able to reach the altitude of the mission aircraft.

- 3 -

TOP SECRET

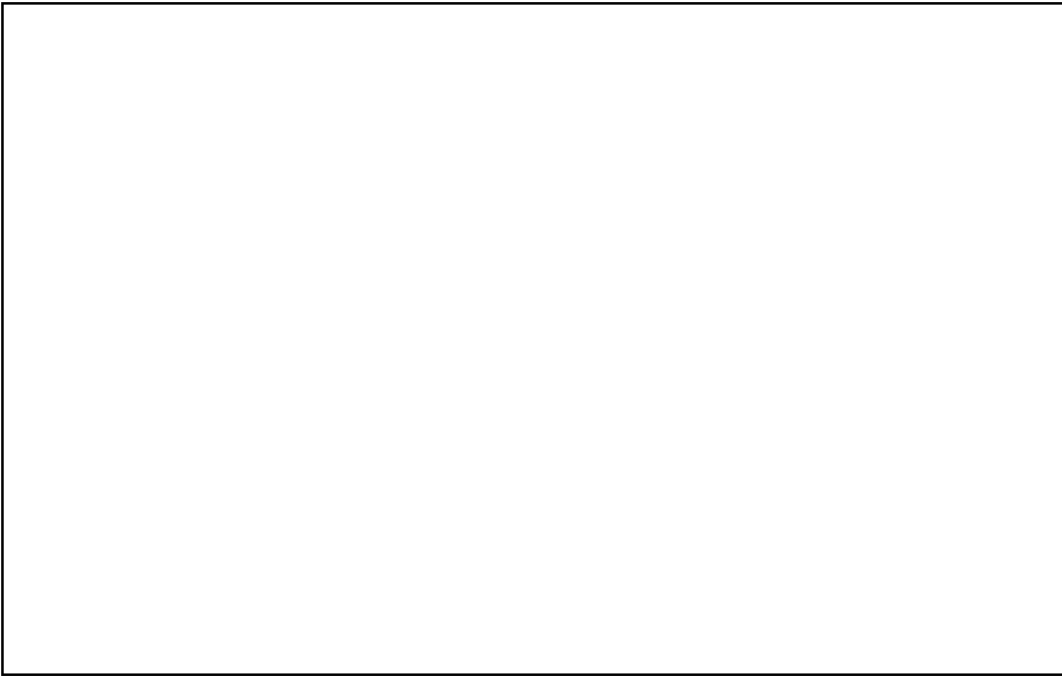
25X1

TOP SECRET

25X1

SC-02164-58

25X1



The electronics equipment employed in the Soviet air defense system included items to perform all of the necessary functions. EW and GCI radar, AI radar, landing aids, navigation aids, communication, identification, missile guidance, and AAA fire control equipment are available. Nearly all of the electronics equipment is mobile, this being especially true of the large ground radars. Ground radar sites include more than one equipment. Use of multiple frequency bands at a single site is commonplace. The most common EW and GCI radars are the 70 mc/s region and the 3000 mc/s region. The 600 mc/s region seems to be coming into use for EW or GCI use with the introduction of new equipment. AI radar operates in the 9000 mc/s band. Fig. 1 is a simplified representation of frequencies now used in the Soviet air defense system.

- 4 -

25X1

TOP SECRET

25X1

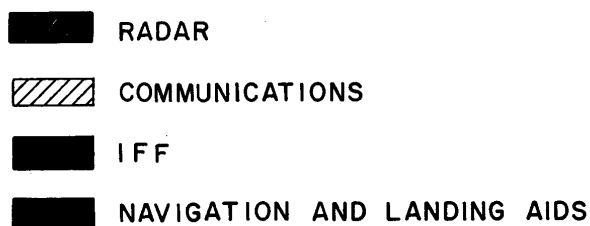
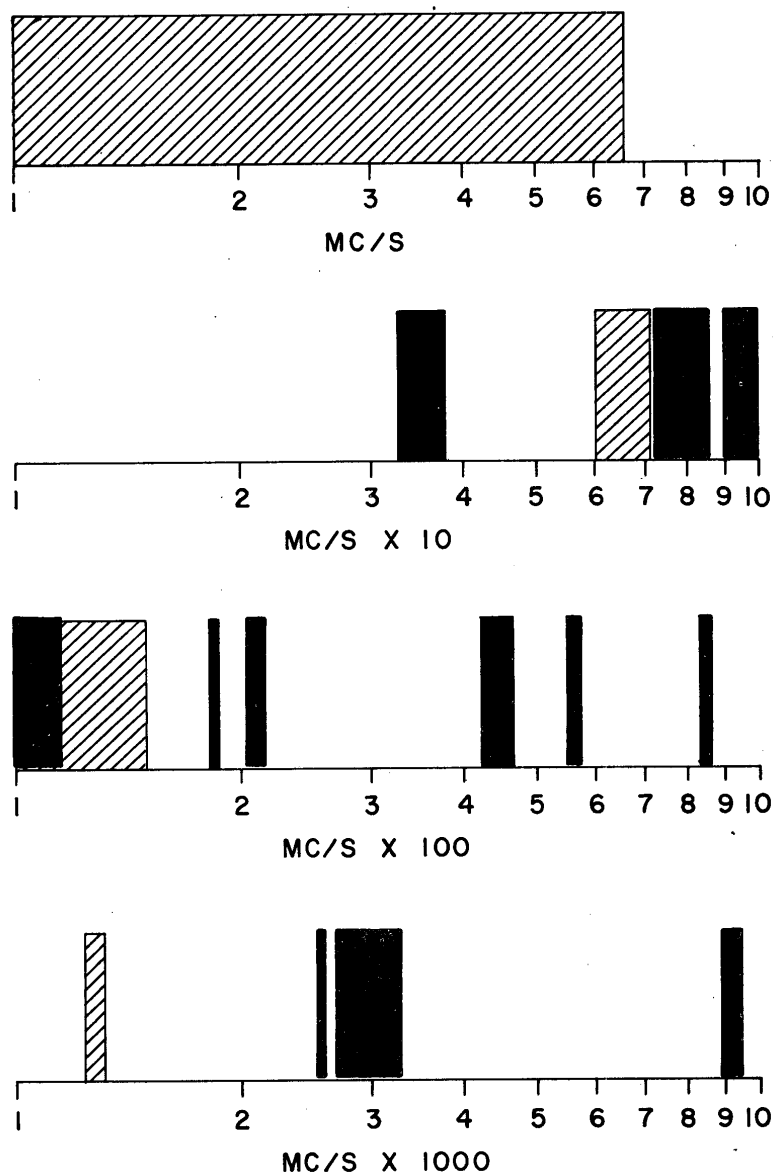


FIG. 1  
MOST USED FREQUENCIES IN THE  
SOVIET BLOC AIR DEFENSE SYSTEM

TOP SECRET

25X1

TOP SECRET

25X1

SC-02164-58

## DISCUSSION

INTRODUCTION

The Soviet air defense system is a vast, complex organization covering more area and employing more electronic equipment than any other air defense system in the world. This all-source study assesses the electronics aspects of the Soviet air defense system. The resulting assessment is based chiefly on the performance the system has exhibited in reaction to a million miles or more ( a half million within the past two years) of Western aircraft flights along the periphery as well as penetration over Soviet Bloc territory. In order to aid in the appreciation of the systems' performance, a brief outline of its organization and method of functioning precedes the information on actual demonstrated performance. The important electronics equipment used in the system is then briefly discussed.

In the process of the study it was discovered that virtually no statement concerning the Soviet air defense system could be made without finding conflicting information. Rather than clutter the paper with a recitation of exceptions and conflicting data, an attempt has been made to present the general situation as it is believed to exist and to hereby warn the reader of the conflicting data problem.

In the section pertaining to system performance, many altitude reports [ ] will be found. These should not be interpreted to be as accurate as the number of significant figures would indicate because these altitudes are converted to feet [ ] which is usually in hundreds of meters. For example, 10,000 meters converts to 32,810 ft.

Soviet leaders seem to have been impressed with three important facts at the end of World War II, i.e., the role of airpower during the war, US possession of the atomic bomb and means for its delivery, and the absence of air defenses of the USSR. Faced with these facts, the USSR undertook an ambitious program to provide air defenses. It is believed that the highest priority was given to their development. It is difficult to assess the relative priority of Soviet atomic weapons research in comparison to air defense, but clearly their bomber development to provide a delivery capability did not enjoy near the priority accorded air defense. Perhaps the first evidence of this large effort was the rapid growth of their jet fighter strength which had reached significant proportions prior to 1950. By 1951 the results of their efforts in electronics for air defense began to appear and important advances have marked each year since that time.

The air defense system has been the subject of almost continuous revision and modification and this process continues today. Improvements in organization, methods of operating, and equipment are continually noted.

The size of the air defense system alone is worthy of note. Literally thousands of radars plus thousands of other essential electronics items are used in the system. While this may seem surprising, the inventory of jet fighters alone is some 14,000 aircraft.

TOP SECRET

25X1

TOP SECRET

25X1

SC-02164-58

ORGANIZATION

The Soviet Air Defense of the Homeland, PVO Strany (Protivo Vozdushnaya Oborona Strany) as well as the Soviet Air Forces became separate headquarters entities sometime in 1955.

At the Ministry of Defense level the responsibility for air defense of the USSR, PVO Strany, is in the hands of Marshal S. S. Biryuzov who is Deputy Minister for Air Defense and Commander in Chief of the Air Defense Forces. This position is one of four coequal independent components of the Ministry of Defense, the others are the Commanders in Chief for Ground Forces, Air Forces, and Naval Forces who are also Deputy Ministers of Defense. The Commander in Chief of the Air Defense Forces, like the CinCs of the other forces, reports directly to the Minister of Defense, however, the Main Staff of the CinCs are subordinate to the General Staff which is also headed by a Deputy Minister of Defense. The General Staff is an executive and operational body in addition to its planning, organizational, and training responsibilities.

The Air Defense Forces derive equipment and personnel from the Ground, Naval, and Air Forces. The Commander in Chief, Air Defense Forces has operational control over all forces engaged in air defense while administrative control of these forces remains with their parent service. Thus, the Chief Air Defense component within the USSR, the Fighter Aviation of Air Defense (IA PVO), is supplied by the CinC Air Forces to the CinC Air Defense Forces for operational use. Likewise the Naval Forces supply Tactical Naval Aviation units and the Ground Forces supply anti-aircraft artillery and presumably guided missiles.

The Tactical Air Forces fighters also have an air defense role under the CinC Air Defense Forces while within the USSR, and under the Commander of Groups of Forces outside the USSR, [REDACTED]

25X6

The operational control of the Soviet air defense system appears to be concentrated in two centers, the main PVO Command Post for Europe located in Moscow and the main PVO Command Post for the Far East located in Khabarovsk. The main Command Post in Moscow appears to be primarily responsible for operations in Europe and the central USSR although its authority has also been noted overriding the authority of the Far East Main PVO Command Post at Khabarovsk.

The Air Defense District (ADD) is the basic organizational and operational unit in the Soviet air defense system. The ADD covers a major geographic area and the ADD Commander is responsible for conducting air defense operations in his District. ADDs are usually divided into two or more subdistricts. The ADDs provide the subdistricts with the personnel, equipment and facilities to conduct air defense operations, e.g., air surveillance and warning, identification, communications, raid plotting and filtering, fighter aircraft and weapons, and means for their control.

In the western portion of the Soviet Bloc the Satellite national air defense organizations function as part of the Soviet system essentially as ADDs. The air defense organizations in the Satellite nations definitely function under Soviet guidance and are almost entirely dependent on the USSR for air defense equipment. Likewise, in the Far East the Chinese Communist and North Korean air defense systems are coordinated with the Soviet system and for all practical purposes function as an extension of the Soviet system.

The present ADD structure found in the Soviet air defense system has changed over many years and is still changing as the Soviets deem improvements necessary. The boundaries of the ADDs are frequently changed and there has been some tendency to make the boundaries coincide with the Military Districts within the USSR.

- 6 -

TOP SECRET

25X1

SC-02164-58

THE AIR DEFENSE WARNING SYSTEM

The warning system of Soviet air defenses is the VNOS (Vozdushnoye Nablyudeniye, Opoveshcheniye i Svyaz' - Air Observation, Warning and Communications). In the past the VNOS has been associated with visual/sonic observation posts but at present the most significant information is provided by VNOS radar installations which are equipped with IFF interrogators for identification of aircraft within their range.

A common grid system for aircraft position reporting is employed throughout the Sino-Soviet Bloc. This system is based upon latitude and longitude with the largest unit being one degree of latitude by one and one-half degrees of longitude. These grids "squares" are subdivided according to a standard pattern, into thirds in the north-south and east-west dimensions giving nine "squares" each of which in turn is subdivided in the same manner so that the smallest "square" is one eighty-first of the original basic grid unit. This smallest "square" is a rectangle about 6-8 nautical miles on a side with the actual dimensions dependent upon the latitude. In some areas this smallest unit is again divided into quarters. These units represent the accuracy of the early warning system which is limited by the size of the grid square rather than the range and bearing accuracy of the radars employed.

A recent development in the form of a data transmission system may alter this basic grid reporting system. This development which is known to Western intelligence as INERT will be discussed in detail later in the paper.

At the present time the VNOS or early warning system uses a vast and flexible communications network. While most of the available information indicates a heavy usage of high frequency radio telegraphy to transmit warning data, telephone and teleprinter systems on both radio and land line are also used.

DATA HANDLING IN THE AIR WARNING SYSTEMRadar

Data handling and processing in the air warning system begins at the lowest echelon with the radar sites. Visual observers are presumed to be used but are considered essentially ineffective. It appears that the radars are assigned specific geographic areas of coverage in which they are responsible for reporting aircraft. The coverage capabilities of these radar sites appear to be greater than their assigned area of responsibility because they are frequently noted reporting tracks of aircraft outside their assigned areas. However, when multiple tracks are involved, the radars tend to adhere more firmly to their assigned boundaries.

The radars report to subdistrict filter centers and receive instructions from these filter centers. The radar stations usually report aircraft positions in terms of range and azimuth from the radar site using local track numbers. Although radars have been noted passing position reports in terms of the VNOS grid system, this does not seem to be a normal procedure. A comparatively recent development is the passing of course and speed by the radars to the filter centers.

- 7 -

TOP SECRET

25X1

TOP SECRET

25X1

SC-02164-58

Filter Centers

Filter centers are located at the Subdistrict, ADD, and probably at the Main PVO Command Post levels. The filter centers at Subdistrict headquarters level receive radar reports which are processed to place the data in a standard format and remove duplicate tracks. The data is then transmitted to ADD filter centers where further filtering occurs and the data is passed to the Main PVO Command Post. At each level, including at times the reporting radar, reports on tracks are transmitted to adjacent commands to keep them aware of the air situation and to alert them to tracks approaching their area. This system appears to function effectively since many lengthy tracks have been carried across several ADDs without too much evidence of difficulty.

The filtering process at the Subdistrict filter center involves placing the radar report into a standard PVO format. The track reporting messages include:

Raid Number	(4 digits from assigned block)
VNOS Grid Location	(6 digits identifying location, in some areas 7 digits)
Time Group	(Moscow time)
Altitude	(passed intermittently in increments of 100 or 500 meters depending on radar)
Course	(passed intermittently in 10° increments)

Other data, including aircraft types and speed, number of aircraft and instructions or qualifiers such as "alert all radars", "target faded", "tracks merging", "interception proceeding", "jamming activity", "I am passing control", "raid leaving area of tracking responsibility", "ceasing tracking", etc. are also passed intermittently in the form of trinomies in the standard format.

When three or more tracks occur in a single area the filter centers usually use a shortened format where only limited data is transmitted regularly.

Filter centers receive information from other sources than the radars they control. Visual observations are also received, but as previously stated, they are not thought to be significant because of their lack of precision and timeliness.

In addition the filter centers receive flight plans to correlate with reported tracks to aid in identification.

Data from Naval observation posts, also known as SNIS (Sluzhba Nablyudeniya i Svyazi, Communications and Observation Service) posts are combined in the air warning system usually after some filtering within the Naval channels. The SNIS responsibility appears to include ship movements in addition to aircraft movements. It appears that SNIS air warning data are probably introduced at the ADD filter center level.

In order to keep interested elements up to date on the air situation a broadcast service exists throughout all levels of PVO. Moscow broadcasts the overall air situation which the ADDs receive. The ADDs in turn broadcast to other ADDs and are found rebroadcasting to their own elements the

TOP SECRET

25X1

SC-02164-58

air situation they have received from remote ADDs. These broadcasts appear to supplement or be supplemented by alert instructions and warnings that raids are approaching. This broadcasting network also supplies data for operational troops, e.g. artillery and fighter units, Long Range Air Army, Field Army Commands, and Naval units.

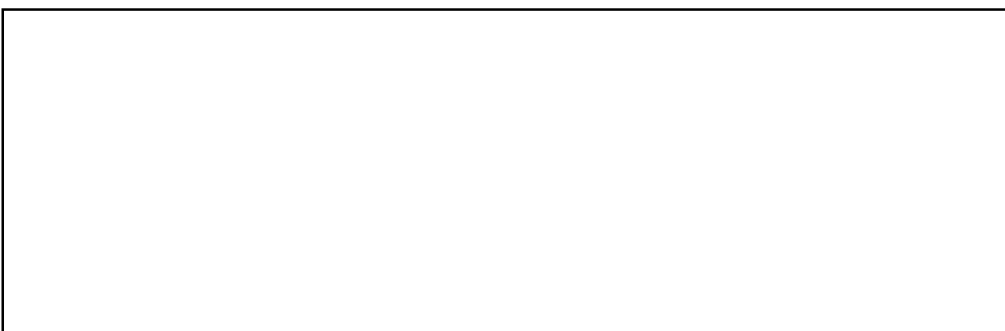
INERT

Since mid-1956 two new digital data reporting systems have been noted in the Soviet air defense system. Because the characteristics of the transmissions in these systems are technically similar, they are called by the same name, INERT, in US [redacted] However, one system transmits radar plot data from radar sites to a filter center using high frequency radio and for convenience this will be called HF INERT in this report. The other system transmits GCI commands to interceptors on very high frequency (VHF) radio and will be called VHF INERT in this report. The introduction of HF and VHF INERT is believed to indicate the Soviet introduction of a system similar in concept to the US SAGE. The Soviet name for this system is FAKIR.

25X1

HF INERT appears to take highly accurate azimuth and range data directly from the radar and transmit it in digital form to the filter center where it is probably processed by semi-automatic or automatic means. While advances are being made in our knowledge of this system, much of its function and capability is conjecture at the present time. The system has been spreading throughout the Western USSR and while it is known to be associated with GCI or EW/GCI radar sites, it is not yet clear that it is used by sites which have only the EW role. Reporting above the subdistrict filter center level via HF INERT has not yet been clearly established.

While HF INERT is assumed to be still in an introductory or test phase, it has the advantage of adaptability to machine processing with the consequent saving in time which should result in a much greater traffic handling capacity in the face of multiple tracks.

Rate and Capacity

25X1

There appears to be a one to five minute lapse of time from aircraft detection by a radar until the track is transmitted to the subdistrict filter center. The average plotting rate of the radar station is about one plot per minute. The lag at the radar station is probably due to the time required for identification of the track and securing enough data to be sure that the observation is in fact a new track.

- 9 -

TOP SECRET

25X1

TOP SECRET

25X1

SC-02164-58

The time lag involved in the filtering of reports at the subdistrict filter center varies from one to five minutes. The time required by the ADD filter center appears to be about one to ten minutes. The average plot production rate of filter centers is about 27-30 per hour. Rates as low as 15 and as high as 50 or more per hour have been noted. When several tracks are present the plot production rate increases but the reporting rate on each track is reduced.

The reports of track data from the ADDs are filtered and rebroadcast by Moscow with delays which average from three to ten minutes. Lags up to 30 minutes have been noted. The air situation broadcast by Moscow has been observed transmitting about 160 plots per hour.

The cumulative time of reporting from the radar station to Moscow then averages between three and twenty minutes and in some cases even better reporting has been noted, e.g. it takes about two minutes for a message from Shenyang in Communist China to be passed to Moscow via Khabarovsk and plots from Far East radars have been transmitted to Moscow via Khabarovsk in three to eight minutes.

Retelling of plots between ADDs averages between one to ten minutes although delays of an hour have been noted perhaps due to congestion of facilities. The long delays do not seem to be common in the vertical reporting structure.

It should be noted that because of the collocation of filter centers and fighter control centers within Subdistricts and ADDs, action can be initiated in one to five minutes at the Subdistrict level and in two to ten minutes at the ADD level.

Normally the air defense warning system functions smoothly and efficiently when a single target or track is involved. However, when a number of tracks in a single area must be covered the reporting system reaches a saturation point. The saturation point occurs when plot passing on each track is too infrequent to maintain track continuity. It has been variously estimated that this occurs when somewhere between five and ten tracks are present. Various schemes to reduce the saturation problem have been noted such as shortened reporting format, omission of friendly tracks, and delays of crosstelling between ADDs. The consequences of this saturation appears to be that the higher echelons fall behind in their knowledge of the air situation. It is not clear that the saturation point in filter center reporting equates to saturation of the air defense system preventing counter action being undertaken. Because of the collocation of fighter direction centers at the filter centers, it seems likely that action at the local level can still take place and actual saturation of the defenses may not occur until a somewhat greater number of tracks is present.

The introduction of INERT may be expected to increase materially the number of tracks which can be handled before saturation occurs. [ ] analysis of INERT intercepts has revealed as high as 22 simultaneous tracks having been passed via this system on one occasion. In this case each of the 22 tracks was reported at intervals of one minute eight seconds.

TOP SECRET

25X1

SC-02164-58

Fighter Control

The basic command element of the Bloc fighter forces is the fighter division. The fighter division is composed of three regiments having three squadrons each. Each regiment has 37 fighters.

The precise relationship between the fighter division and the ADD headquarters or Subdistrict headquarters is not entirely clear. While the divisions are subordinate to the ADD or Subdistrict headquarters where decisions are made to engage with various weapons, there are indications that fighter division commanders may also have this authority. Probably under some circumstances the division commanders may initiate action on their own authority, but in general this decision probably rests with the ADD or subdistrict headquarters.

It has been mentioned previously that a fighter control center is collocated at ADD and subdistrict headquarters together with the filter centers which keep track of the air situation. It is likely that fighter divisions are located or are represented at these fighter control centers and in this manner control by the fighter divisions is effected. In any event, the GCI responsibility is in the hands of the fighter divisions which have GCI radars to carry out the mission. Actually, GCI radars appear to be available on a regimental basis, although it is not entirely clear whether or not the role of these sets is more for flight control than for operational GCI use.

The usual procedure is for the ADD headquarters (or Subdistrict headquarters) to alert a fighter division. On receipt of a scramble order, the division orders one or more of its regiments to dispatch interceptors. The division GCI controller will take control of the aircraft as soon as it is airborne if it is within range of the division radar or, if too far away, control will be under a regimental GCI controller. The flight is ordered by the controller to proceed to a specified location, giving speed and altitude to be achieved upon arrival at the assigned location. It is believed that, at least in peace time, the authority to shoot must be given by the ADD headquarters.

When the division GCI controller orders the flight to return to base, control usually reverts to the regiment under whose direction the landing is made.

A typical Soviet GCI exercise includes three major phases. In the first phase the pilot is vectored by the controller to a point where the target is acquired by the airborne intercept (AI) radar in the fighter. The second phase consists of the fighter maneuvering into position and closing in range until the AI radar can be switched from the search to the tracking mode. In the third and final phase the pilot makes his simulated firing pass on the target and breaks away. The distance at breakaway varies from one kilometer to 200 meters depending upon individual pilot.

Close control is usually used by the GCI controller although broadcast control is sometimes used, depending upon the number of tracks involved. When broadcast control is used position, altitude, and track information on the target is broadcast and the fighters are essentially "on their own" to complete the interception. Airborne fighters have been noted on patrol or orbiting under GCI control in anticipation of reported raids headed for their area. Control during these times is more likely to be of the broadcast type. During the later stages of GCI operation, the rate of transmissions from the controller increases with small course corrections and changes of altitude ordered. The controller usually attempts to place the fighter above, behind, and to the left of the target.

- 11 -

TOP SECRET

25X1

TOP SECRET

SC-02164-58

Direction finder assistance is available on request by fighter pilots returning to base and is quickly given by ground stations. In periods of good or fair visibility landings are effected singly or in pairs at 30-40 second intervals for a landing time of 12-15 minutes per regiment. Blind landing aids and procedures are also available and used.

Limitations appear to exist in the fighter system in terms of the numbers of aircraft which can be controlled in GCI operations by a single radar. This number appears to be about four interceptor flights although one flight may consist of several fighters. Another limitation has existed due to the employment of VHF communications equipment having only four channels. This communications limitation is especially obvious when it is realized that the USSR possesses a vast number of fighter aircraft, estimated at about 14,000 fighters. The USSR appears to have recognized this problem and the introduction of the ground to air data link, VHF INERT, seems to be their approach to the solution. As previously mentioned, INERT is a data transmission system having two functions, one on high frequency radio HF INERT which is used to transmit aircraft tracking data between ground installations and the other which transmits GCI control data via VHF radio (VHF INERT) to the fighter where instructions are believed to be presented in visual form. VHF INERT transmissions include aircraft addresses and flight commands. It is believed most likely that computers are employed on the ground to either aid in the GCI controller function or to perform it on an automatic basis.

Another limitation of Soviet fighters appears in their seeming commitment to a "tail chase" attack. This is related to the armament of the fighters which is a gun package involving 37 mm and 23mm automatic guns with rather low muzzle velocity (circa 2200 feet per second) and a low rate of fire (circa 400-500 rounds per minute). The airborne intercept radar (SCAN ODD) which will be discussed under Electronics Equipment for Air Defense, is compatible with the armament system in terms of range, and being essentially limited to "tail chase" interceptions.

#### Deployment

The succeeding pages present the deployment of the Soviet air defense system in chart form based on data to 1 December 1957. See Figures 2-17. These charts, which include most of the Air Defense Districts, show ADD and Subdistrict boundaries, filter centers, and communications in addition to the air order of battle and the radar order of battle. Many locations are   accurate only so far as they indicate the general area. For this reason further study would be required if this information were to be used for specific operational mission planning.

A total of 1098 radar site locations are shown and this is believed to be between 65% and 75% of the total in use. The remainder is not shown because the location has not been determined, although reporting of numbers of unlocated stations to filter centers is known.

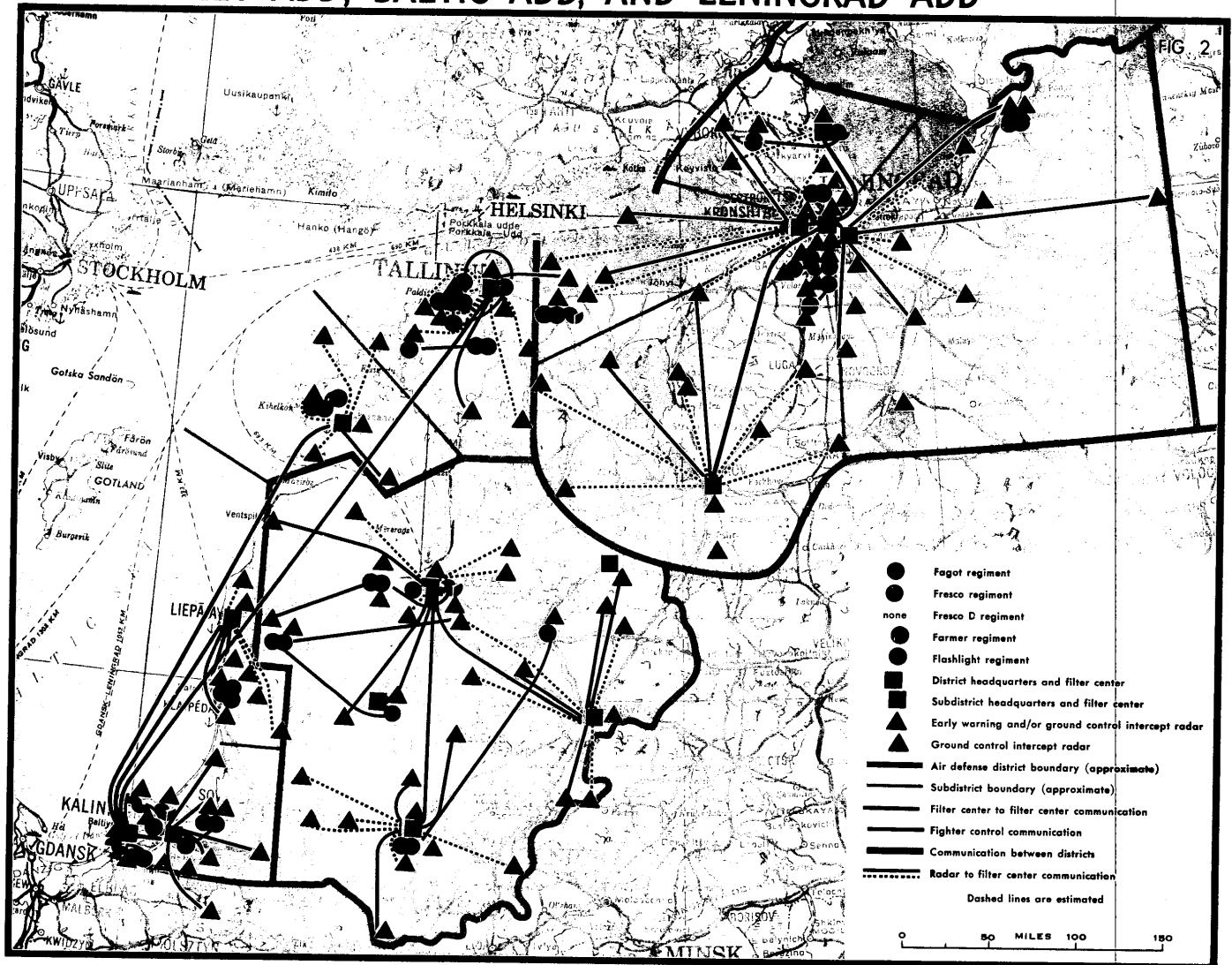
TOP SECRET

25X1

TOP SECRET

25X1

# BALTIC FLEET ADD, BALTIC ADD, AND LENINGRAD ADD



G-752

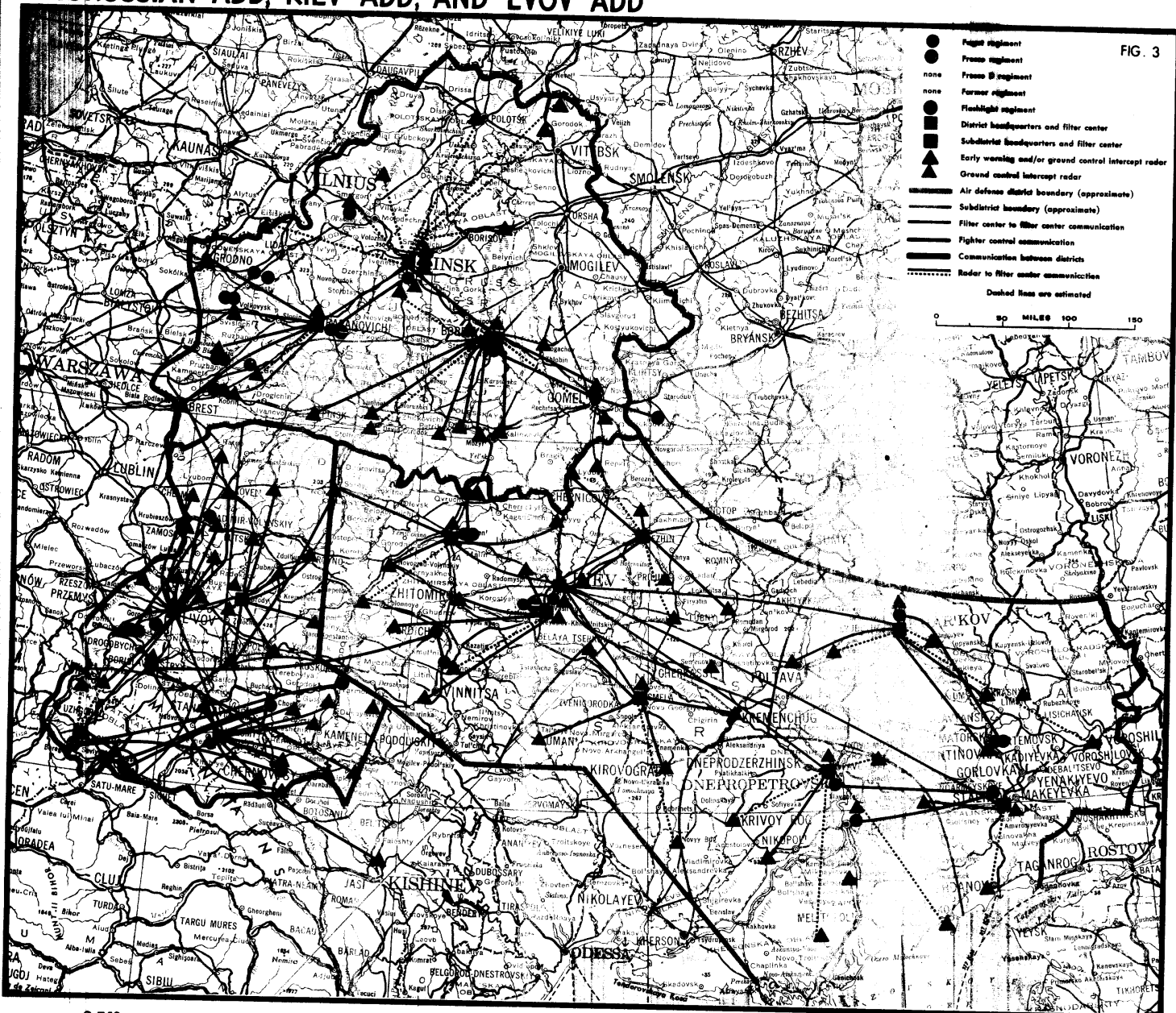
TOP SECRET

25X1

TOP SECRET

25X1

## BELORUSSIAN ADD, KIEV ADD, AND LVOV ADD



G-753

TOP SECRET

25X1

**CHUKOTSK ADD**



TOP SECRET [ ]

25X1

25X6

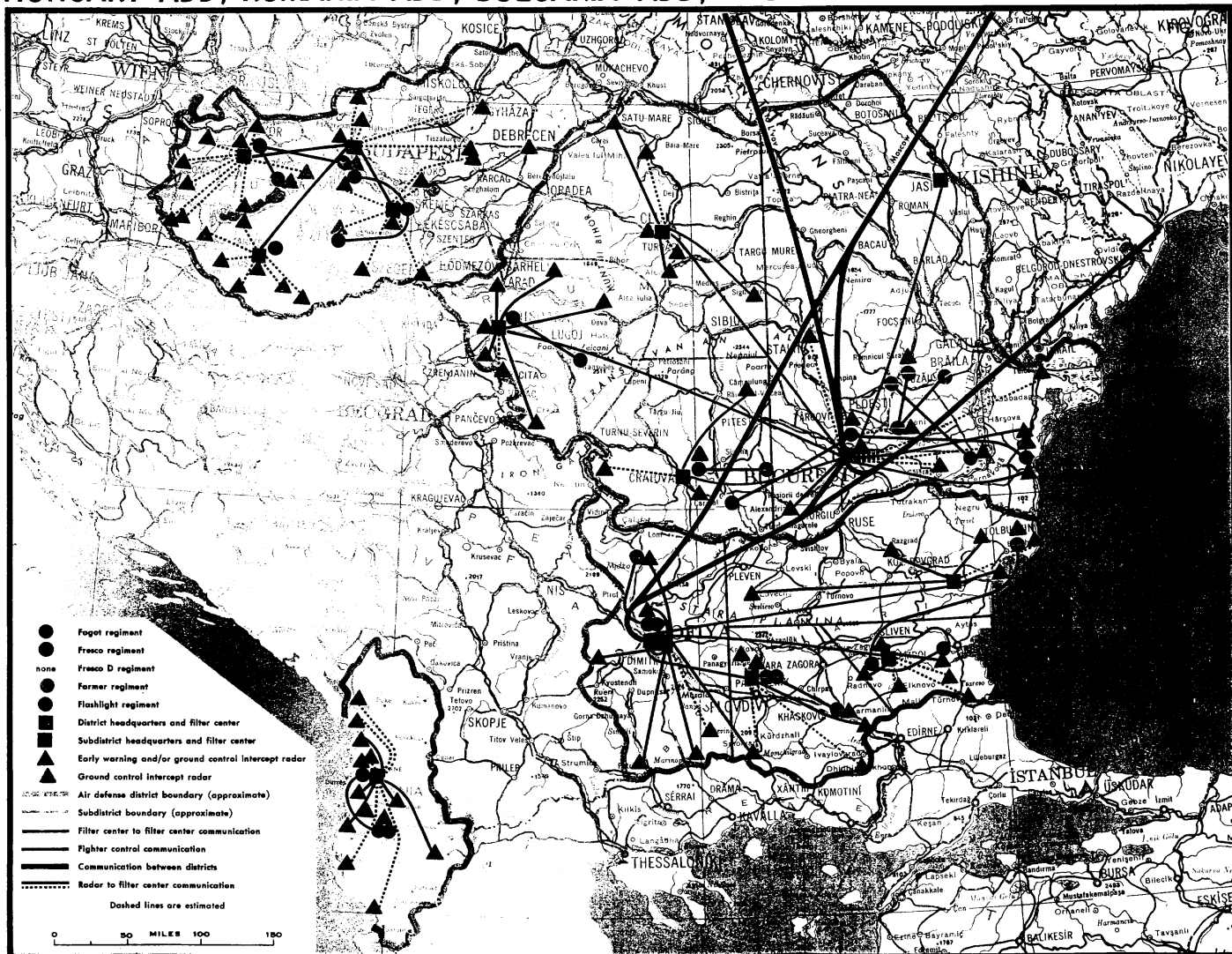
Approved For Release 2003/12/19 : CIA-RDP78T04753A000800010002-3

Approved For Release 2003/12/19 : CIA-RDP78T04753A000800010002-3

TOP SECRET

25X1

## HUNGARY ADD, RUMANIA ADD, BULGARIA ADD, AND ALBANIA ADD



G-756

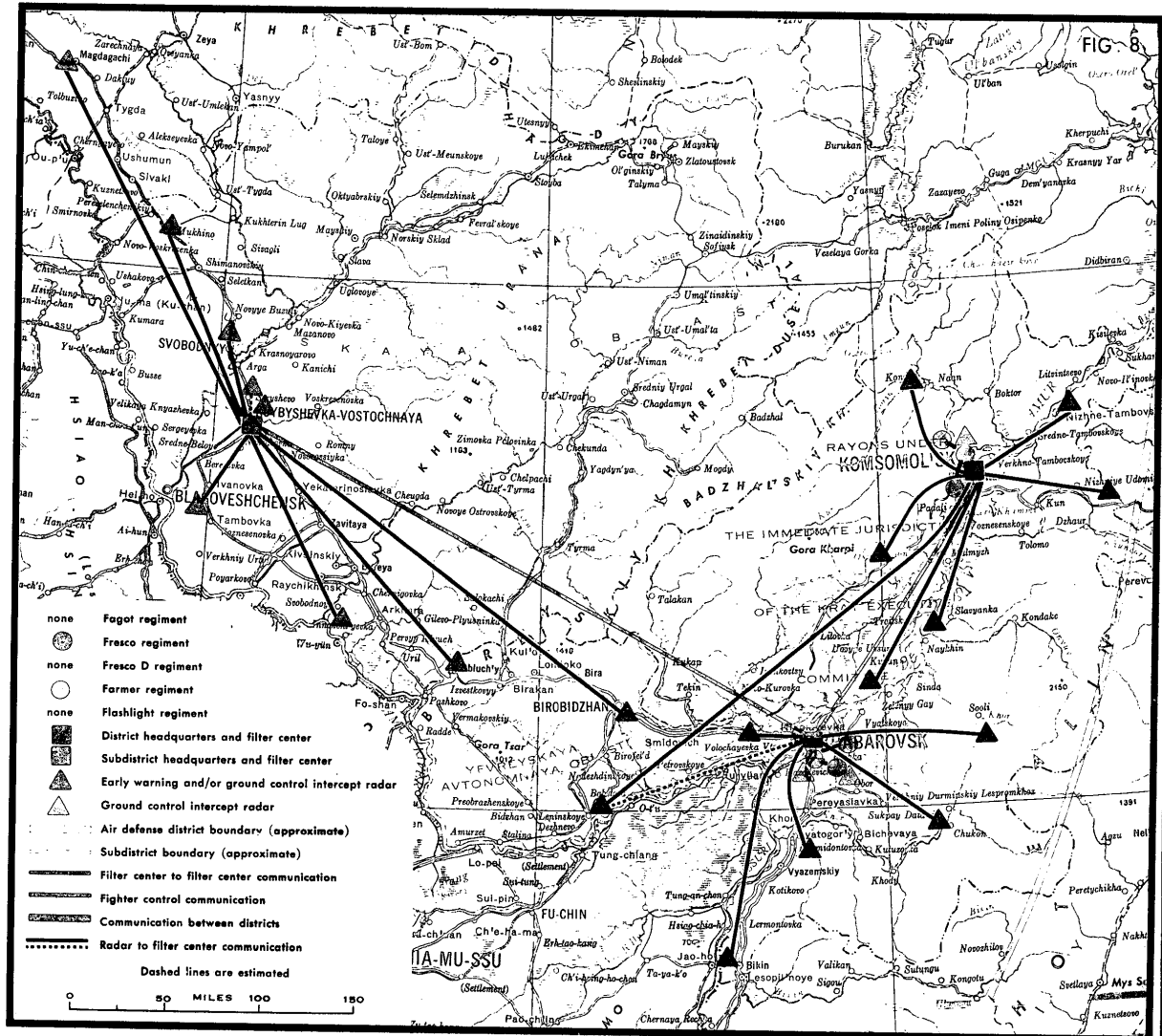
TOP SECRET

25X1

25X1

TOP SECRET

## Khabarovsk ADD



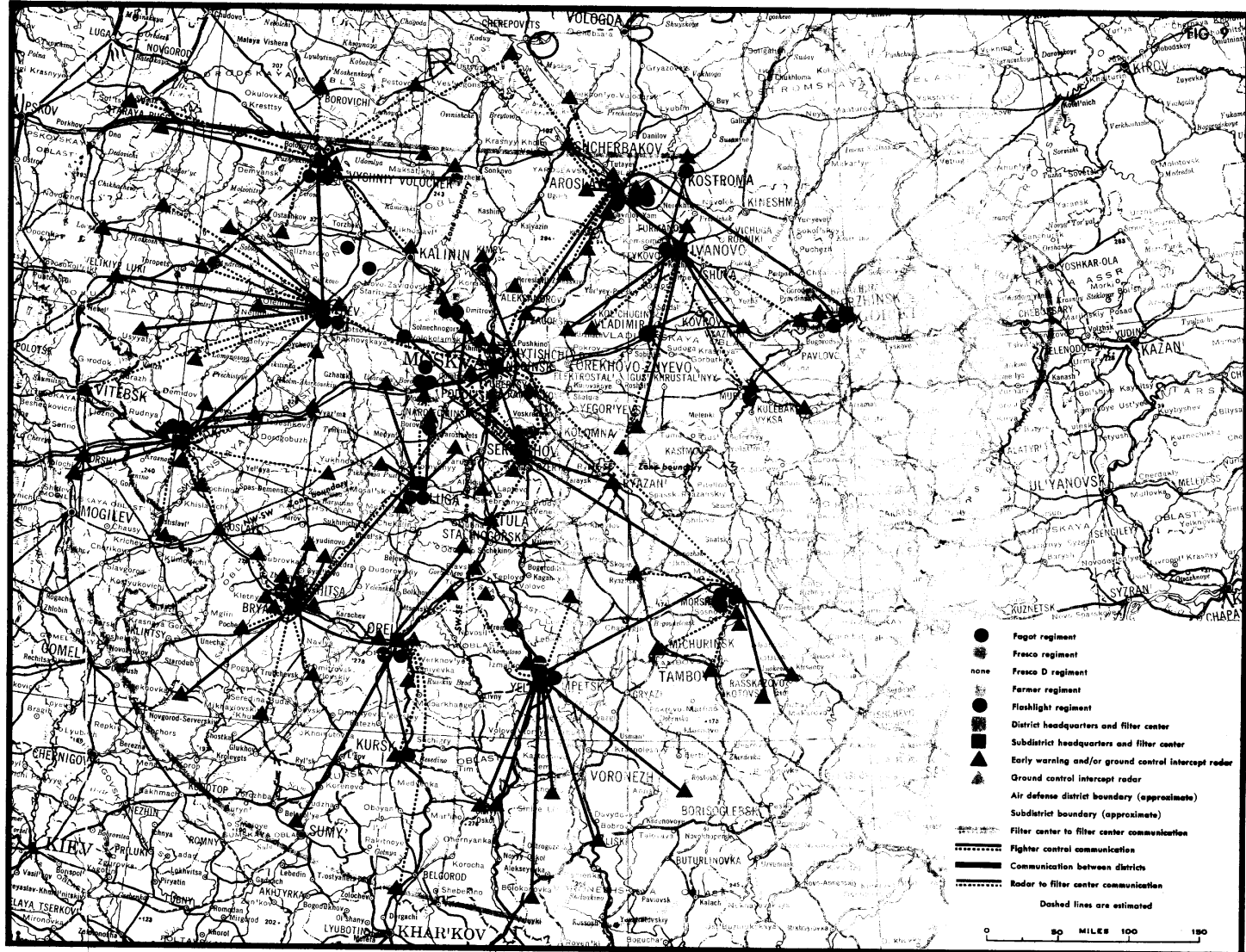
G-758

TOP SECRET

TOP SECRET

25X1

MOSCOW ADD



G-759

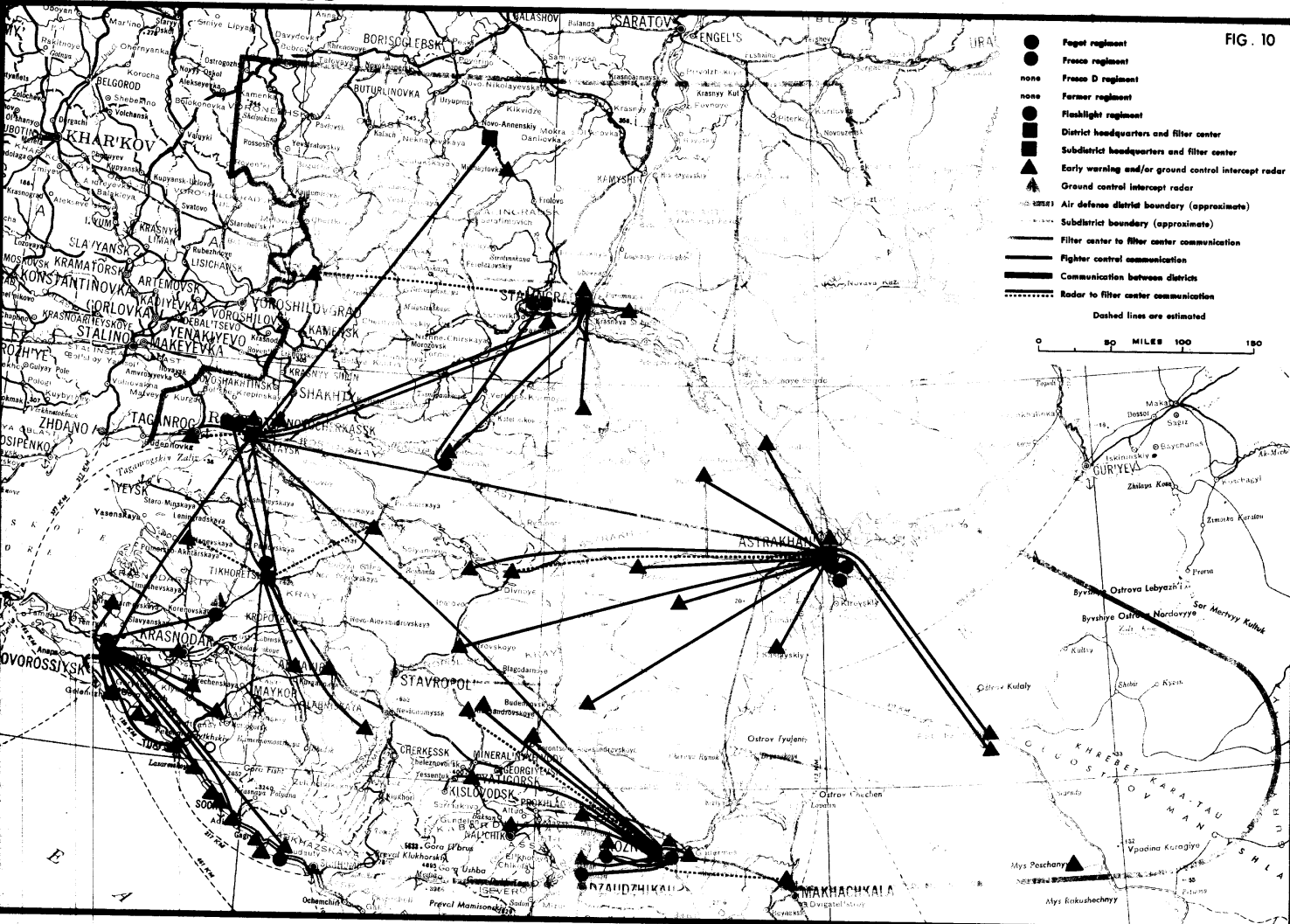
TOP SECRET

25X1

TOP SECRET

25X1

## NORTH CAUCASUS ADD



G-760

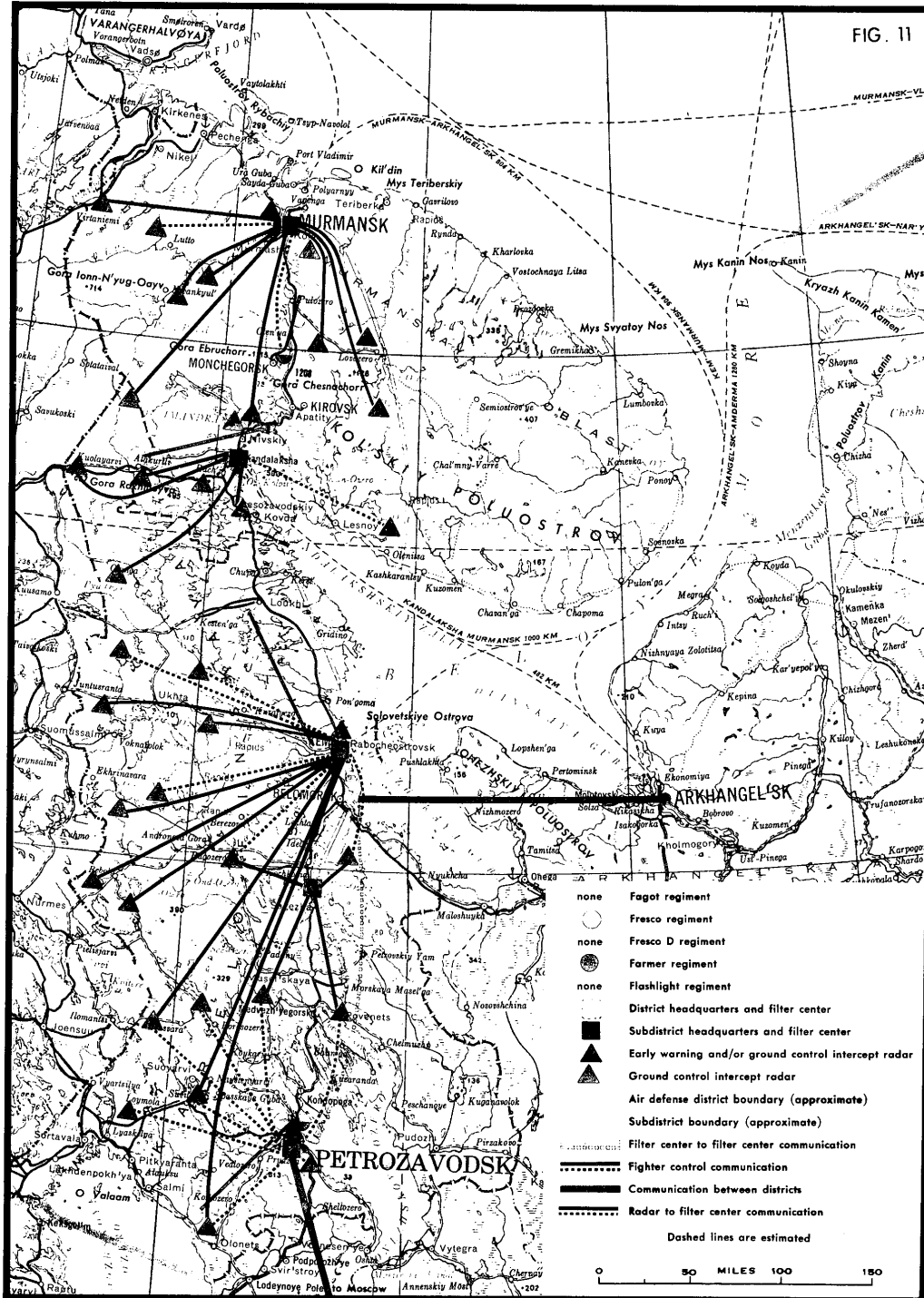
TOP SECRET

25X1

TOP SECRET

25X1

## NORTHERN ADD



G-761

TOP SECRET

25X1